WHAT IS CLAIMED IS:

1. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein

the strain element is wound like a coil, and electrodes are formed on an inner circumferential surface and an outer circumferential surface.

2. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a metal coil wound like a coil;

the strain element is formed on at least one of an inner circumferential surface and an outer circumferential surface of the metal coil; and

an electrode is formed on a surface of the strain element.

3. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the strain element is wound like a coil;

an electrode having a width narrower than a width of the strain element is formed on an upper surface of the strain element along a side portion of one of an inner circumferential side and an outer circumferential side; and

an electrode having a width narrower than the width of the strain element is formed on a lower surface of the strain element along a side portion of an opposite side of that of the upper surface.

4. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a metal coil wound like a coil;

a strain element having a width narrower than a width of the metal coil is formed on an upper surface of the metal coil along a side portion of one of an inner circumferential side and an outer circumferential side;

a strain element having a width narrower than the width of the metal coil is formed on a lower surface of the metal coil along a side portion of an opposite side of that of the upper surface; and

electrodes are formed on surfaces of the strain elements.

5. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a metal coil wound like a coil;

two belt-shaped strain elements each having a width of not larger than half of a width of the metal coil are formed side by side on at least one of an upper surface and a lower surface of the metal coil; and

electrodes are formed on surfaces of the strain elements.

6. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the strain element is wound like a coil;

an electrode having a height lower than a height of the strain element is formed on an inner circumferential surface

of the strain element along an end portion of one of an upper end and a lower end; and

an electrode having a height lower than the height of the strain element is formed on an outer circumferential surface of the strain element along an opposite end portion of that of the inner circumferential surface.

7. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a metal coil wound like a coil;

a strain element having a height lower than a height of the metal coil is formed on an inner circumferential surface of the metal coil along an end portion of one of an upper end and a lower end;

a strain element having a height lower than the height of the metal coil is formed on an outer circumferential surface of the metal coil along an opposite end portion of that of the inner circumferential surface; and

electrodes are formed on surfaces of the strain elements.

8. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a metal coil wound like a coil;

two belt-shaped strain elements each having a height of not larger than half of a height of the metal coil are formed side by side on at least one of an inner circumferential surface and an outer circumferential surface of the metal coil; and

electrodes are formed on surfaces of the strain elements.

9. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the strain element is belt-shaped;

an electrode having a width narrower than a width of the strain element is formed on one surface of the strain element along one side portion; and

an electrode having a width narrower than the width of the strain element is formed on the other surface of the strain element along the other side portion.

10. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a belt-shaped metal plate;

a strain element having a width narrower than a width of the metal plate is formed on one surface of the metal plate along one side portion;

a strain element having a width narrower than the width of the metal plate is formed on the other surface of the metal plate along the other side portion; and

electrodes are formed on surfaces of the strain elements.

11. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a belt-shaped metal plate;

two belt-shaped strain elements each having a width of not larger than half of the metal coil are formed side by side

on at least one surface of the metal plate; and

electrodes are formed on surfaces of the strain elements.

12. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

both end portions of the strain element are spirally wound; and

electrodes are formed on an inner circumferential surface and an outer circumferential surface of the strain element.

13. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the actuator includes a metal coil having both ends spirally wound;

the strain element is formed on at least one of an inner circumferential surface and an outer circumferential surface of the metal coil; and

an electrode is formed on a surface of the strain element.

14. An actuator provided with a strain element having a property of a piezoelectric inverse effect, wherein:

the strain element is spirally wound;

electrodes are formed on an inner circumferential surface and an outer circumferential surface of the strain element; and

a dielectric is provided in parallel with the strain element.

15. An actuator provided with a strain element having

a property of a piezoelectric inverse effect, wherein:

the actuator includes a spirally wound metal coil;

the strain element is formed on at least one of an inner circumferential surface and an outer circumferential surface of the metal coil;

an electrode is formed on a surface of the strain element; and

a dielectric is provided in parallel with the strain element.

16. An actuator according to any one of claims 1 to 13, further comprising a dielectric in parallel with the strain element.

17. An actuator according to any one of claims 1 to 16, wherein the strain element is a laminated strain element.

18. A method of manufacturing a strain element, comprising the steps of:

forming a coating film of titanium or a titanium compound on a surface of a cylindrical mold;

shaping the coating film, which has been formed on the surface of the cylindrical mold, like a coil;

forming a crystal film of a strain element having a property of a piezoelectric inverse effect by hydrothermal synthesis on the coating film shaped like the coil; and

removing the strain element from the cylindrical mold.

19. A method of manufacturing a strain element according

to claim 18, further comprising a step of forming a crystal film of a strain element having the property of the piezoelectric inverse effect by the hydrothermal synthesis on an inner circumferential surface of the strain element removed from the cylindrical mold.

20. A method of manufacturing a strain element according to claim 18 or 19, further comprising:

a step of forming a coating film of titanium or a titanium compound on an outer circumferential surface of the strain element removed from the cylindrical mold; and

forming a crystal film of a strain element having the property of the piezoelectric inverse effect by the hydrothermal synthesis on the coating film formed on the outer circumferential surface of the strain element.

21. A method of manufacturing a strain element, comprising the steps of:

forming a hydrophilic region into a coil shape on a surface of a cylindrical mold made of a water-repellent resin as a base material;

dipping the cylindrical mold in a solution containing suspended fine particles of a strain element having a property of a piezoelectric inverse effect;

pulling up the cylindrical mold; and

removing the adherent strain element from the cylindrical mold.

22. A method of manufacturing a strain element, comprising the steps of:

performing a water-repellent treatment so that a hydrophilic region is formed into a coil shape on a surface of a cylindrical mold made of a hydrophilic resin as a base material;

dipping the cylindrical mold in a solution containing suspended fine particles of a strain element having a property of a piezoelectric inverse effect;

pulling up the cylindrical mold; and

removing the adherent strain element from the cylindrical mold.

23. A method of manufacturing a strain element according to claim 21 or 22, further comprising a step of performing a hot isostatic press to the cylindrical mold before the adherent strain element is removed from the cylindrical mold.

24. A method of manufacturing a strain element according to any one of claims 21 to 23, further comprising the steps of:

forming an electrode on at least one of an obverse surface and a reverse surface of the strain element removed from the cylindrical mold;

dipping the strain element again in the solution containing the suspended fine particles of the strain element having the piezoelectric inverse effect; and

pulling up the strain element.

25. A method of manufacturing a strain element, comprising the steps of:

laminating fine particles of a strain element having a piezoelectric inverse effect in a vessel; and

irradiating laser light simultaneously with the laminating step to melt and sinter the fine particles of the strain element.